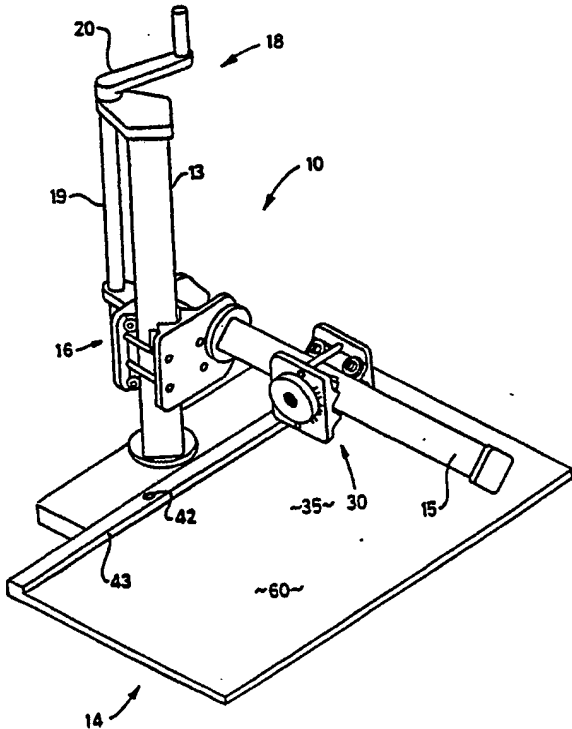


PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>4</sup> : <b>B23Q 3/02, 1/20, 1/26</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 90/05043</b> (43) International Publication Date: <b>17 May 1990 (17.05.90)</b></p>
<p>(21) International Application Number: <b>PCT/AU89/00473</b> (22) International Filing Date: <b>6 November 1989 (06.11.89)</b> (30) Priority data: PJ 1302                      4 November 1988 (04.11.88)    AU PJ 2729                      14 February 1989 (14.02.89)    AU (71)(72) Applicant and Inventor: <b>YARKER, Keith [AU/AU];</b> Lot 3, Bunya Road, North Arm, QLD 4561 (AU). (74) Agent: <b>PIZZEY, John, Kingston; Pizzey and Company,</b> Level 6, 444 Queen Street, Brisbane, QLD 4000 (AU). (81) Designated States: <b>AT, AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CF (OAPI patent), CG (OAPI patent), CH, CM (OAPI patent), DE, DK, FI, FR (European patent), GA (OAPI patent), GB, HU, IT (European patent), JP, KP, KR, LK, LU, MC, MG, ML (OAPI patent),</b></p>		<p>MR (OAPI patent), MW, NL, NO, RO, SD, SE, SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.  <b>Published</b> <i>With international search report.</i></p>
<p>(54) Title: <b>LINEAR MOTION APPARATUS</b></p> <p>(57) Abstract</p> <p>A linear motion apparatus (10) includes an elongate rectangular supporting shaft (13) and a carriage (16) slidable along the supporting shaft (13). The carriage includes opposed roller bearings (26) which are arranged at opposite sides of the supporting shaft and are in contact with the respective surfaces of the supporting shaft (13). The roller bearings are carried by the carriage (16) about the rectangular supporting shaft (13).</p> 		

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Faso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic	KR	Republic of Korea	SN	Senegal
CG	Congo	LI	Liechtenstein	SU	Soviet Union
CH	Switzerland	LK	Sri Lanka	TD	Chad
CM	Cameroon	LU	Luxembourg	TG	Togo
DE	Germany, Federal Republic of	MC	Monaco	US	United States of America
DK	Denmark				

# "LINEAR MOTION APPARATUS"

This invention relates to linear motion apparatus which is particularly suited for mounting tools and the like and to tool mounting apparatus.

Linear motion machines are used in many applications such as for guiding saws, drills and routers to perform straight-line machining operations. Typically, such machines are made either in a very rudimentary form in which low accuracy of movement is achieved or in a sophisticated form using machined slides and the like in which high accuracy of movement is achieved. The latter types of machines are often expensive and cumbersome.

This invention aims to alleviate the above disadvantages and to provide linear motion apparatus which will be reliable and efficient in use. Other objects and advantages of this invention will hereinafter become apparent.

With the foregoing and other objects in view, this invention in one aspect resides broadly in linear motion apparatus including:-

an elongate supporting shaft;  
a carriage slidable along said supporting shaft and including opposed carriage portions arranged at opposite sides of said supporting shaft and having respective shaft contacting members which engage respective longitudinal face portions of the supporting shaft, and  
connector means for connecting the opposed carriage portions to one another about said supporting shaft.

In the preferred form the supporting shaft is a polygonal shaft and said contacting members are constituted by rollers which roll along said longitudinal face portions and which are preferably arranged in opposed pairs on the respective carriage portions. Of course, if desired one carriage portion could support a single contacting member for maintaining the opposite carriage portion in its operative position and the other carriage portion could include

sufficient contact members for maintaining lateral and elongate stability with respect to the supporting shaft.

In the preferred form each carriage portion supports a pair of rollers at each end for rotation about respective axis whereby opposed ones of each pair of rollers engage adjacent faces of a polygonal supporting shaft. It is also preferred that the connector means for connecting the carriage portions together includes opposed tension members located intermediate the respective pairs of rollers and able to be selectively tensioned to apply balanced engagement forces between the rollers and the supporting shaft. Suitably the tension members are in the form of bolts arranged at opposite sides of the supporting shaft and adapted to be tightened to draw the carriage portions together about the supporting shaft.

It is also preferred that the linear motion apparatus be in the form of a metal fabrication in which the supporting shaft is a rectangular hollow section and the carriage portions are plate-like mounting members provided with brackets for supporting roller or ball bearing rollers with their axes parallel to their respective engagement faces of the shaft. Suitably the brackets are formed by welding angle members to the mounting members in spaced parallel relationship and the roller bearings are secured to the respective outermost faces of the spaced angle members.

In a further aspect this invention resides broadly in a radial arm type mounting assembly including a mounting post or shaft and a radial arm or shaft connected to said mounting post by a carriage which combines with the mounting post to form a linear motion apparatus of the type described above and there being provided a further carriage assembly on said radial arm which combines with the latter to form a further linear motion apparatus of the type described above.

Preferably the radial arm is connected to the respective carriage assembly such that it may be pivoted about and

selectively locked in any angular position with respect to its longitudinal axis. It is also preferred that height adjustment means are provided for supporting the radial arm at selected position along the mounting post and that the further carriage assembly on the radial arm be adapted to support machining apparatus and the like for selective pivotal movement about an axis transverse to the radial arm and the mounting post.

Preferably the mounting post extends upwardly from a table assembly having a platen which is pivotable about an axis disposed parallel to the axis of the mounting post and positioned in line with the machining head or bit of the machining apparatus. Preferably the pivot axis passes through a fence extending along one side of the platen. It is also preferred that there be provided locking means for locking the platen in a pivotally adjusted position.

In order that this invention may more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate typical embodiments of the present invention and wherein:-

FIGS. 1 and 2 illustrate an embodiment of the invention adapted for supporting a router;  
FIG. 3 illustrates the components of the carriage assemblies for the mounting post and the radial arm;  
FIG. 4 is a front view of a tool mounting.  
FIG. 5 is a side view of the tool mounting.  
FIG. 6 is a plan view of an adaptor for mounting a router to the tool mounting, and;  
FIGS. 7 and 8 illustrate in side and plan views an adaptor for mounting a drill to the tool mounting.

Referring to Figs. 1 and 2 it will be seen that there is illustrated a radial arm supporting assembly 10 adapted for supporting a router 11 (illustrated in Fig. 2) whereby the router 11 may be manipulated to perform selected operations. The radial arm supporting assembly 10 includes a mounting

post 13 formed of rectangular hollow section material and mounted in a socket welded to a supporting base assembly 14 so as to extend at right angles to the lower surface. This arrangement enables the mounting post 13 to be released from  
5 the base 14 for storage or transport.

A radial arm 15 formed of rectangular hollow section material is supported on the mounting post 13 by a carriage assembly 16 which is connected to the mounting post 13 by a height adjusting mechanism 18. The latter comprises a  
10 threaded shaft 19 supported for rotation only on the post 13 and engageable with a complementary threaded portion 17 on the carriage assembly 16. A hand wheel 20 is provided to rotate the shaft 19.

As shown in Fig. 3 the carriage assembly 16 comprises a  
15 pair of opposed mounting plates 22 on each of which are secured two elongate angle members 23 in spaced parallel relationship whereby their inner faces extend at right angles to one another and substantially parallel to the adjacent side faces of the mounting posts 13. The outermost faces 25  
20 of the angle brackets 23 extend at right angles to the adjacent faces of the mounting posts 13 and support respective rollers in the form of roller bearings 26 at each end thereof.

The roller bearings 26 are supported by axles 27 which  
25 are constituted by bolts which project at right angles from the outermost side faces 25 of the angle brackets 23 so that the roller bearings 26 are supported with their outer faces parallel to the adjacent faces of the mounting post 13. The plates 22 are apertured so that four retaining bolts can pass  
30 therethrough to clamp the carriage assembly 16 about the mounting post 13. In this respect the tension of the bolts may be selectively adjusted so as to maintain the desired contact pressure between the roller bearings 26 and the supporting post 13.

35 An apertured flange 28 extends from one side of one

mounting plate 22 to support a stud 28 which projects from the inner end of the radial arm 15. This connection permits the radial arm 15 to be supported by the flange for rotation about its longitudinal axis. The stud 28 is threaded so that  
5 a nut may be mounted thereon and tightened to lock the radial arm 15 in any selected rotational position about its longitudinal axis.

A further two-part carriage assembly 30 is supported on the radial arm 15. This carriage assembly 30 is similar to  
10 the carriage assembly 16, however it utilises a single pair of bolts 31 passing between the mounting plates 32 intermediate the bearings to secure the carriage assembly 30 to the radial arm 15. Adjustment of the bolts 31 will effect a balanced engagement force between the rollers 33 and the  
15 adjacent side faces of the arm 15. A central aperture 34 is formed through one mounting plate 32 so that a turntable 35 (illustrated in Fig. 1) can be adjustably bolted thereto for rotation about its mounting bolt.

Suitable mounting apparatus, such as the router mounting  
20 assembly 40 as illustrated in Fig. 6, may be connected to the turntable 35 to support the appropriate tool with its machining bit either vertically disposed or disposed at any selected angle relative to the supporting base assembly 14. This is achieved by pivoting the tool mounting 40 or 50 with  
25 the turntable 35 and or the radial arm about its pinned connection to the mounting flange 28.

The supporting base assembly 14 includes a fenced platen  
41 disposed at right angles to the mounting post 13 and pivotable about a supporting pin 42 offset from the post 13  
30 and extending through the fence 43 at a position in alignment with the tool bit of the supported tool, which in this embodiment is the router 11. This arrangement enables the platen to be pivoted to move the workpiece relative to the radial arm while at the same time maintaining the fence at a  
35 position at which it will be engaged centrally by the tool

bit irrespective of the positioning of the platen 60. Thus in use the fence will not be machined at various positions along its length and will thus maintain its structural rigidity and ability to guide workpieces and the like.

5       The router mounting assembly 40 includes an apertured turntable mount 51 which is adapted to be securely bolted to the turntable or direct to carriage assembly 30 and locked thereto at any desired angular rotational position. The turntable mount 51 is provided with a pair of spaced parallel  
10       passages 52 which slidably receive guide bars 54. The latter extend from an upper headpiece 55 to a lower replaceable mounting yoke 56 which is formed in two pieces and is adapted to be clamped about the lower ends of the guide bars 54 by through bolting as illustrated. The mounting yoke 56 may be  
15       a mounting for a router, as shown in FIGS. 4, 5 and 6, or it may be a mounting yoke for a drill as shown in FIGS 7 and 8. In the latter case the mounting yoke is provided with a split clamp portion 57 which clamps about the neck of a drill and in the former case the mounting yoke is provided with a pair  
20       of upstanding pins 58 which are received in sockets provided in the router.

A hand operated linkage assembly is provided to reciprocate the mounting yoke 50/56 and associated guide bars 54 through the turntable mounting 51. The linkage assembly  
25       includes a hand lever 60 pivotally connected to the headpiece 55 and to an upper pivot mounting 63 at the upper end 61 of an actuating link 59 which is pivotally connected at its lower end 62 to the turntable mounting 51. The upper pivot mounting 63 is in the form of a split mounting threadedly  
30       engaged with the lower end of the lever 60 and neatly accommodated about a pin 64 fixed to the upper end of the link 59.

The split mounting 63 is adapted to be tightened to clamp about the pin 64 by rotation of the hand lever 60 about  
35       its longitudinal axis. For this purpose the hand lever 60 is



rotatably received in the pivot mounting 65 and circlips 66 are located at opposite sides of the pivot mounting 65 to retain the hand lever 60 in its operative position.

5 The lower end of the hand lever has a reduced diameter end portion 67 which is threaded to engage with the split mounting 63. The collar 68 formed above the threaded end portion 67 engages with a complimentary collar formed internally of the split mounting 63 such that rotation of the hand lever 60 will urge the spaced parts of the split  
10 mounting 63 towards one another and clamp the latter about the pin 64. In this position the hand lever 60 cannot be pivoted and the mounting yoke 56 is disposed in fixed relationship to the turntable mounting 51.

15 An adjustable stop 70 is provided on one guide bar 54 such that it may be moved to an adjusted position to limit the movement of the mounting yoke 56 away from the turntable mounting 51 and thus it may be set to control the depth of cut of the tool supported by the mounting 50.

20 From the above it will be seen that a radial arm mounting assembly for a machine tool utilises linear motion apparatus which may be fabricated from inexpensive materials while maintaining accuracy of operation. Of course if desired components of the apparatus may be cast or fabricated in a different manner to that described such as by utilising  
25 pressed metal members in lieu of the fabricated members illustrated. Furthermore, if desired the platen could be a fixed platen and the supporting posts could be mounted on a suitable bearing to enable it to pivot about its longitudinal axis. Additionally, angular position indicators may be  
30 provided on the various arms and posts so as to provide and indication of a zero reference point or an angular adjustment from the reference point. The posts and arms could be formed from triangular or polygonal members having faces disposed at greater than 90 degrees to one another. In such  
35 installations the rollers may engage only selected ones of

the faces of the post or arm and sufficient to maintain stability between the carriages and their mounting posts or arms.

5       The supporting assembly 10 may be used as a copying machine, either for copying two or three dimensional articles. For this purpose the carriage assemblies 16 may be adjusted for free movement along their supporting shafts and the radial arm 15 may be counter-balanced such as by a weight suspended within the mounting post by a cable passing about a pulley at the top of the, mounting post and to the carriage. 10       A suitable follower means may be associated with the radial arm, either directly or indirectly as desired. Of course the tool mounting can be of any desired form and adapted for mounting any suitable tool.

15       In a further embodiment of the invention the radial arm is provided with a split clamp at one end with is pivotable about the axis of the radial arm and adapted to clamp to a column such as the column of a drill press. Thus the invention may be utilized to modify a drill press to accept a 20       radial arm drill and/or a radial arm, saw or router or the like.

      It will of course be realised that the above has been given only by way of illustrative example of the invention and that all such modifications and variations thereto as 25       would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as is defined in the appended claims.

THE CLAIMS DEFINING THIS INVENTION ARE AS FOLLOWS:-

1. Linear motion apparatus including:-  
an elongate supporting shaft;  
a carriage slidable along said supporting shaft and including opposed carriage portions arranged at opposite sides of said supporting shaft and having respective shaft contacting members which engage respective longitudinal face portions of the supporting shaft, and  
connector means for connecting the opposed carriage portions to one another about said supporting shaft.
2. Linear motion apparatus as claimed in claim 1, wherein said contact members are constituted by rollers.
3. Linear motion apparatus as claimed in claim 2, wherein said supporting shaft is polygonal and said rollers are arranged in opposed longitudinally spaced pairs on the respective carriage portions.
4. Linear motion apparatus as claimed in claim 3, wherein said connector means includes tension members arranged at opposite sides of said supporting shaft and extending between said carriage portions intermediate the respective said pairs of rollers.
5. Linear motion apparatus as claimed in any one of the preceding claims, wherein said tension members may be tensioned to draw said carriage portions together about said supporting shaft.
6. Linear motion apparatus as claimed in any one of the preceding claims, wherein said supporting shaft is a rectangular hollow section and said carriage portions are angle members provided with brackets for supporting rollers in the form of rolling element bearings disposed with their

axes parallel to respective faces of supporting shaft.

7. A radial arm type support assembly including:-

a mounting post assembly;

a radial arm in the form of linear motion apparatus as defined in any one of the preceding claims and mounted on said mounting post assembly;

a carriage which combines with the mounting post to form a linear motion apparatus of the type described above and there being provided a further carriage assembly on said radial arm which combines with the latter to form a further linear motion apparatus of the type described above.

8. A radial arm type support assembly as defined in claim 7, wherein said radial arm is mounted on said mounting post assembly by a mounting assembly whereby said radial arm may be pivoted about its longitudinal axis and selectively lockable in any angular position about said longitudinal axis.

9. A radial arm type support assembly as defined in claim 7, wherein said mounting post assembly is constituted by linear motion apparatus as defined in any one of claims 1 to 6 and said mounting assembly is secured to one said carriage portion of said mounting post assembly.

10. A radial arm type support assembly as defined in any one of claims 7 to 9, wherein said mounting post assembly extends upwardly from a table assembly having a platen which is pivotable about an platen axis disposed parallel to the longitudinal axis of said mounting post.

11. A radial arm type support assembly as defined in any one of claims 7 to 10, wherein the carriage assembly on said radial arm is adapted to support machining apparatus for

selective pivotal movement about an axis transverse to said radial arm.

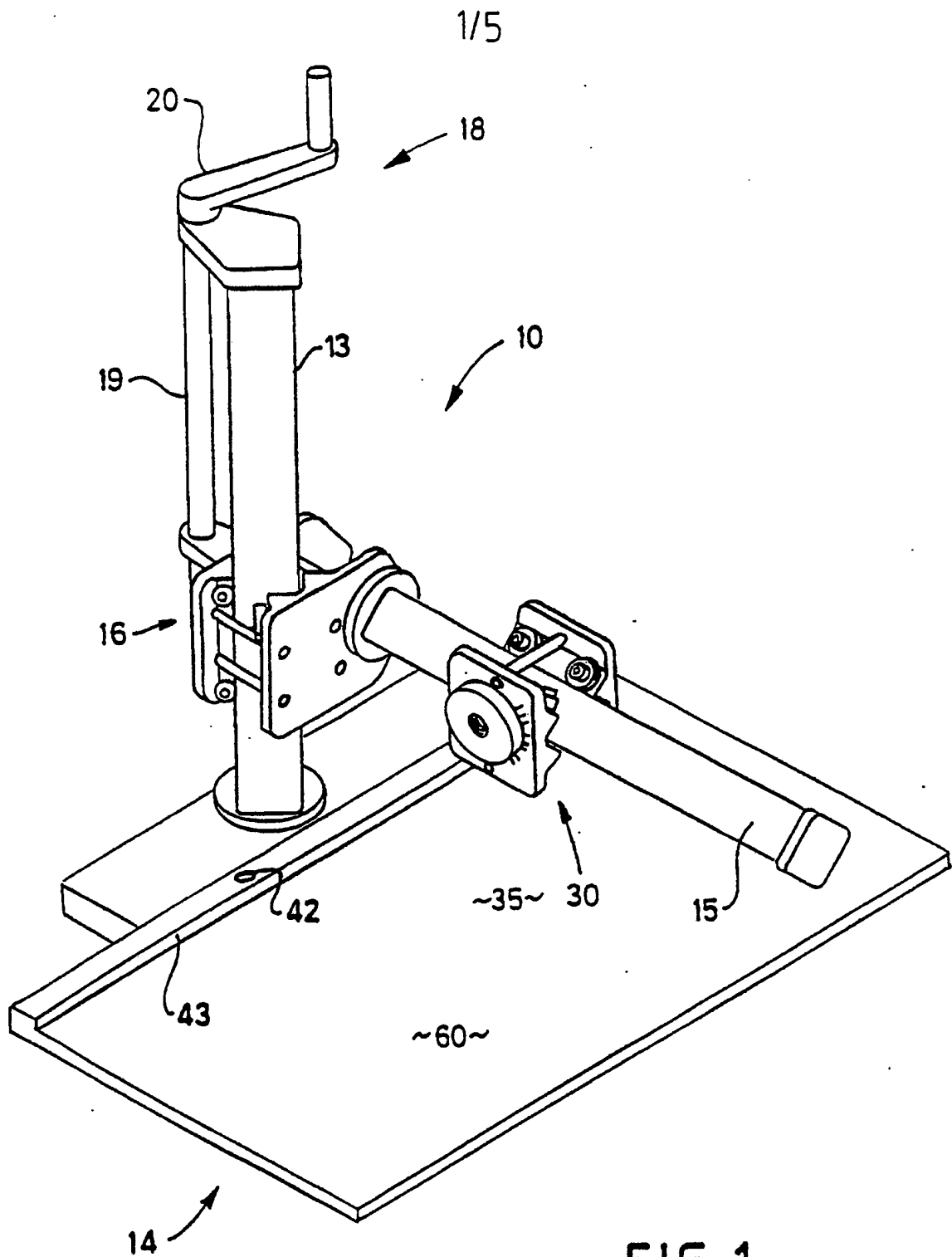
12. A radial arm type support assembly as defined in claim 7 when appended to claim 10, wherein said platen axis is positioned in line with the machining head or bit of the machining apparatus supported by the carriage assembly on said radial arm.

13. A radial arm type support assembly as defined in claim 12, wherein said platen axis passes through a fence extending along one side of said platen.

14. A radial arm type support assembly as defined in claim 13, wherein there is provided locking means for locking said platen in a selected position about said platen axis.

15. Linear motion apparatus as claimed in any one of the preceding claims, wherein said supporting shaft and or said radial arm are formed from rectangular hollow steel sections.

16. Tool mounting apparatus substantially as hereinbefore described with reference to the accompanying drawings.



2/5

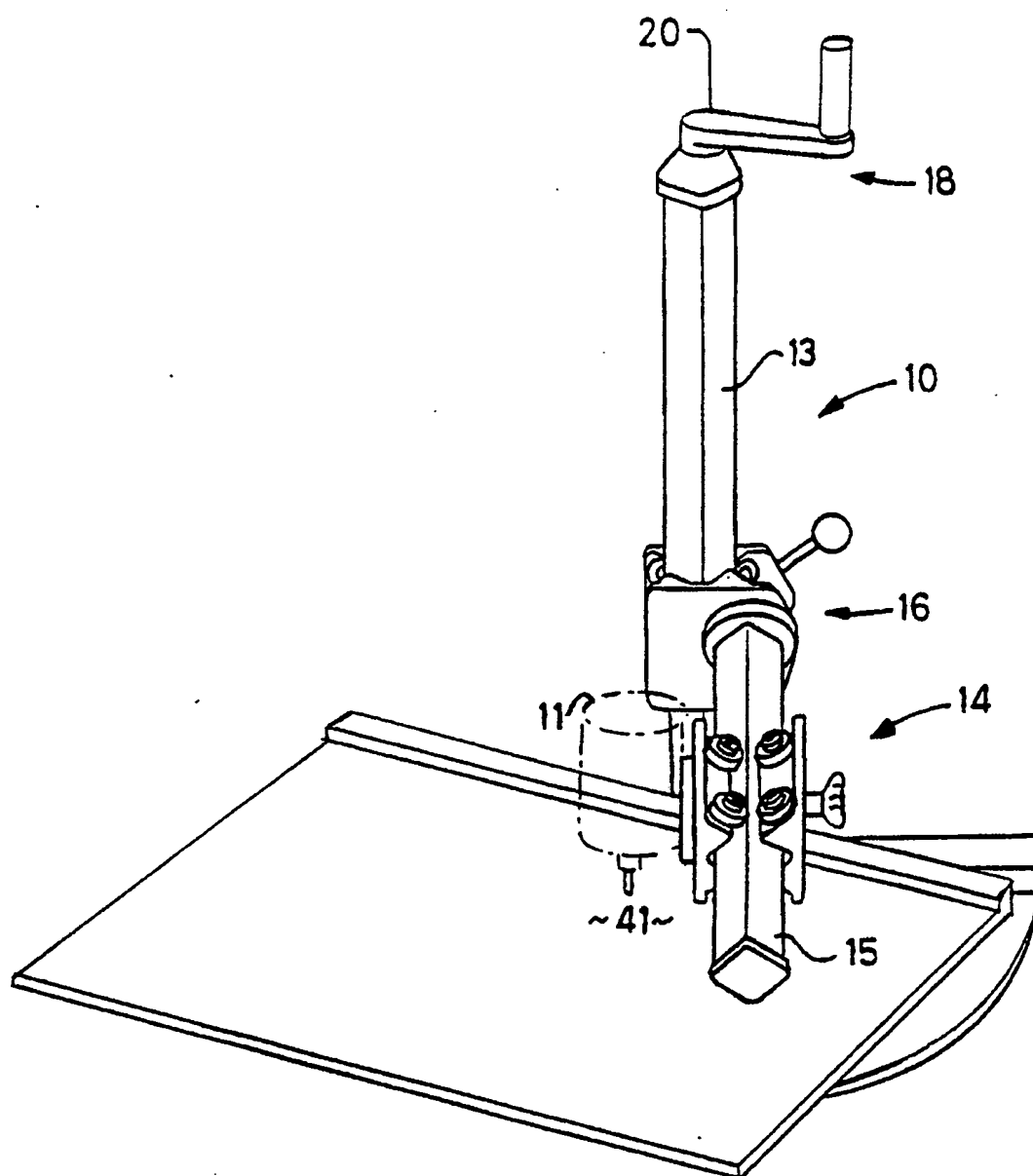
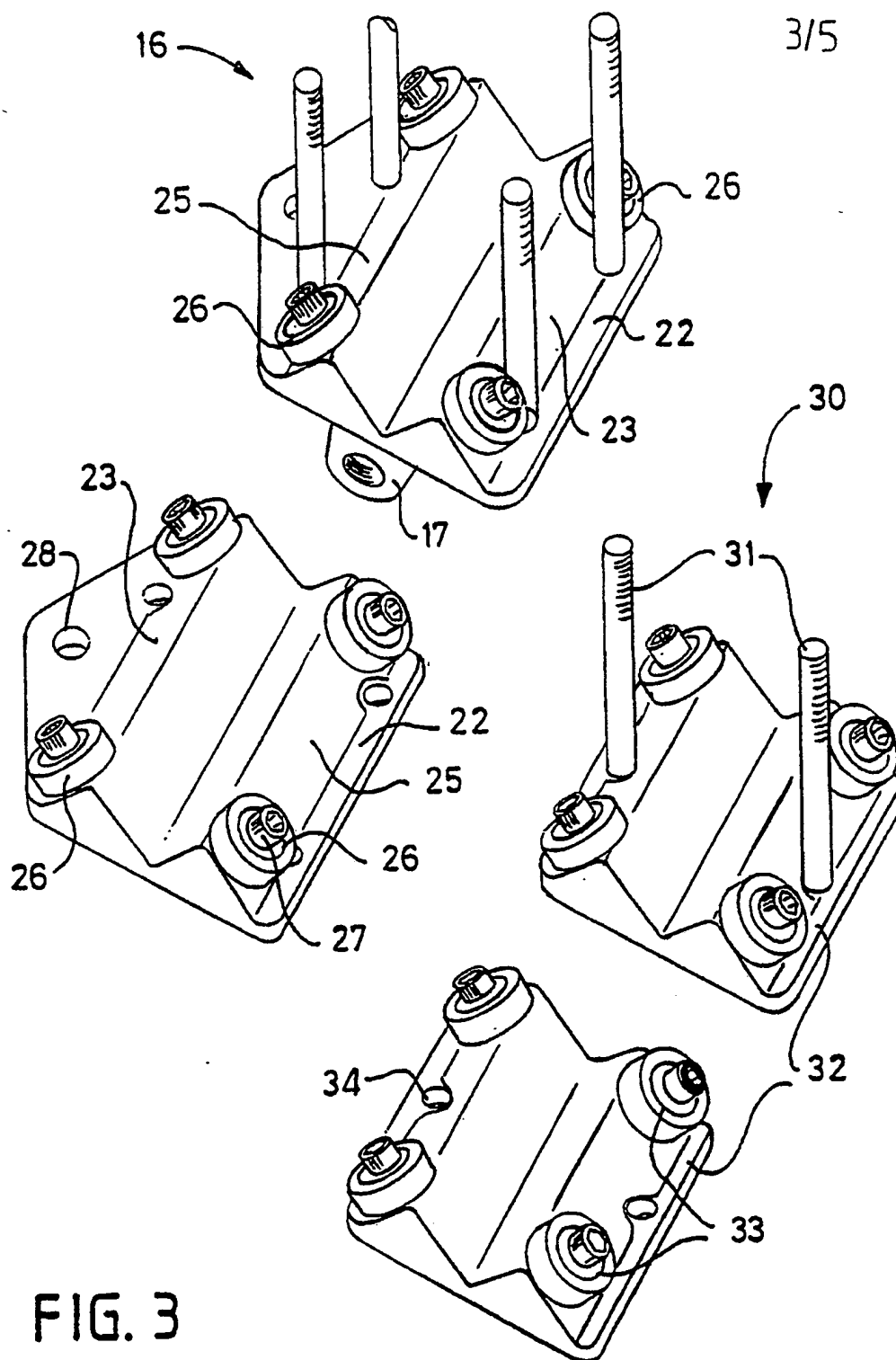
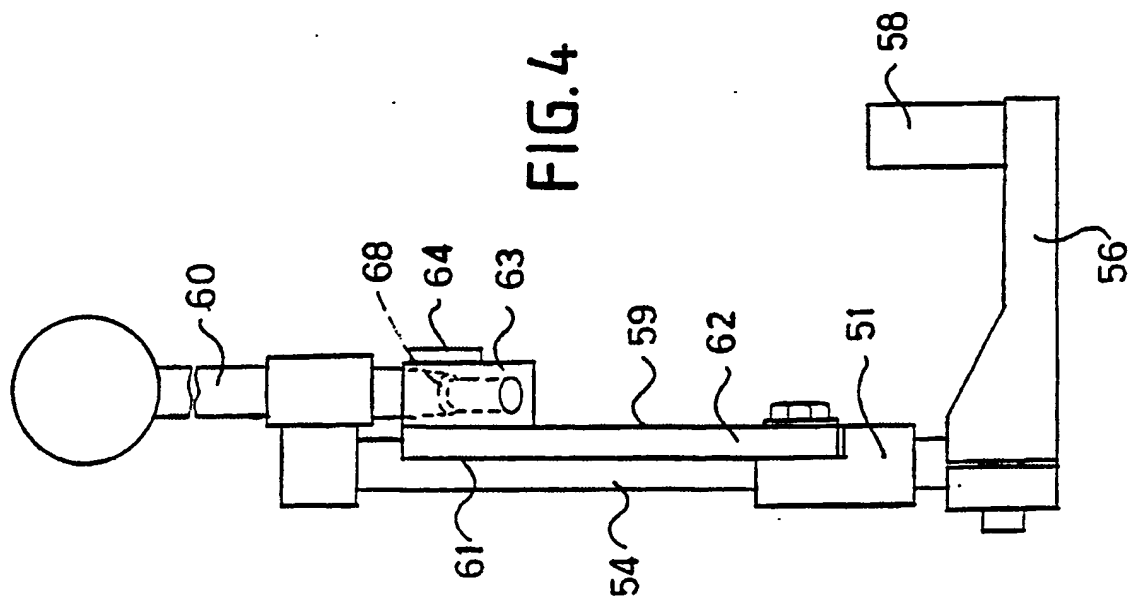
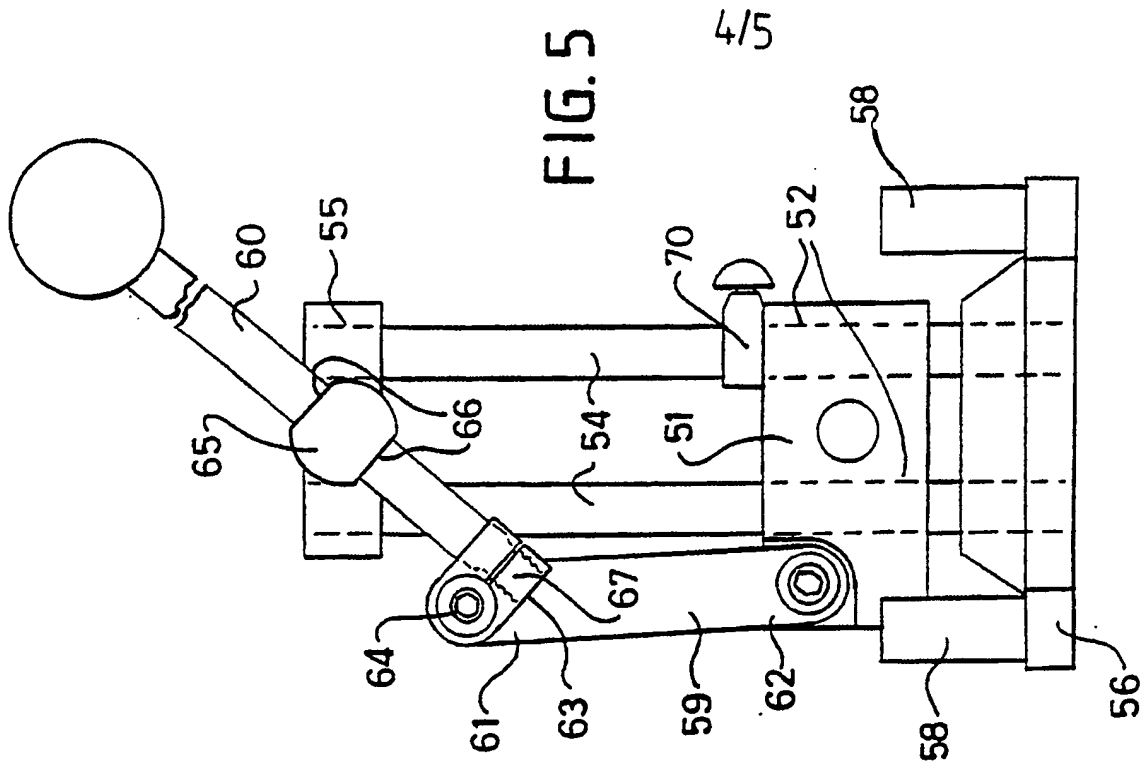


FIG. 2







5/5

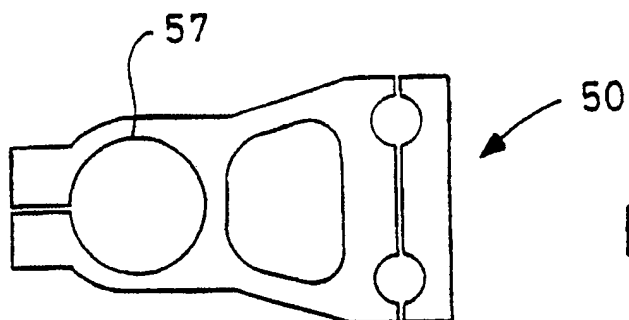


FIG. 8

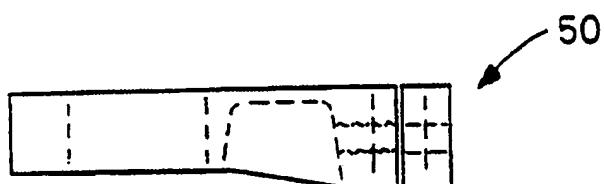


FIG. 7

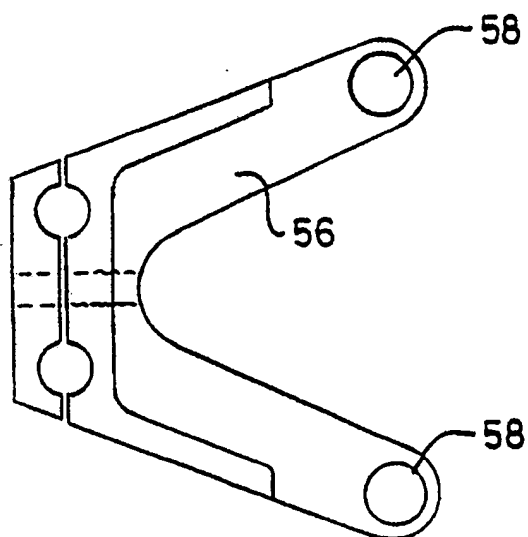


FIG. 6

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 89/00473

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) 6		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. <sup>4</sup> B23Q 3/02, 1/20, 1/26		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched 7		
Classification System	Classification Symbols	
IPC	B23Q 3/02; 1/20, 1/26	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8		
AU: IPC as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> 9		
Category*	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X Y  Y  A A A	GB,A, 2089443 (TERAMACHI) 23 June 1982 (23.06.82) see entire document  DD,A, 215728 (INGENIEURHOCH-SCHULE WISMAR) 21 November 1984 (21.11.84) see Figure 1  GB,A, 1396035 (SCHIESS AKTIENGESELLSCHAFT) 29 May 1975 (29.05.75) US,A, 2552580 (PERSSON) 15 May 1951 (15.05.51) AU,B, 23930/84 (563005) (KYBATO INC) 8 August 1985 (08.08.85)	(1-3, 7) (8-9)  (8-9)    
* Special categories of cited documents: 10		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "G" document member of the same patent family	
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search 8 February 1990 (08.02.90)	Date of Mailing of this International Search Report <b>13 FEBRUARY 1990</b>	
International Searching Authority Australian Patent Office	Signature of Authorized Officer D.G. FRY	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON  
INTERNATIONAL APPLICATION NO. PCT/AU 89/00473

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Members		
GB 2089443	DE 3146330 JP 57101121	FR 2496200	GB 2089443	
GB 1396035	DE 2122204 IT 959684	FR 2135556 US 3761194	GB 1396035	

END OF ANNEX